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A STUDY OF CREATIVE THINKING AS IT RELATES TO MILITARY PROBLEM-SOLVING AND DECISION MAKING IN THE NAVY

WILLIAM DAVID WESSINGER

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William David Wessinger

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by

William David Wessinger

Commander, United States Navy

Submitted in partial fulfillment of
the requirements for the degree of

MASTER OF SCIENCE
IN
MANAGEMENT

United States Naval Postgraduate School
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ABSTRACT

Creative thinking has increasingly been the subject of research in recent years. This study attempts to outline the evolution of knowledge concerning creativity, with particular emphasis on that having practicable application. The utilization of creative thinking in the industrial, educational, and military fields is reviewed. The various proven techniques of enhancing creativity are discussed, together with methods in use to train personnel to use these techniques. The general areas in which the Navy has an apparent need for creativity are pointed out. Broad general conclusions are drawn and recommendations for improvement of the Navy's efforts in these areas are offered.

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CHAPTER I

STATEMENT OF THE PROBLEM

INTRODUCTION

"Where there is no vision, the people perish." (Proverbs 29:18)

There can be no doubt that the essential activities of Naval Officers, as of other managers and executives, involve problem-solving and decision making. Often, the additional requirement of creativity is also imposed. In recent years, the creative aspect of these activities has been receiving particular emphasis. Creativity, like motherhood, has become cloaked with the mantle of "goodness." No article, no book, no lecture, which pretends to deal with the national scene omits reference to innovation and the need for increasing development of the creative potential of scientists, engineers, businessmen, and even members of the Armed Forces.

In a larger sense, the Navy itself may be viewed as a problem-solving, decision making system. A major function of its officer corps, beyond their personal decision making role, is to improve the organization's ability to solve problems and make decisions. This can be done partly by improvement of individual performance, through education and training, and partly by improving the system itself, that is, the organizational structure and the formalized decision making procedures.

An immediate question which comes to mind is "Why does Navy management need to apply creative thinking to its problem-solving, decision making system?"

The most obvious answer, perhaps, is the unprecedented rate of change that has marked the weapons revolution since the advent of the nuclear bomb. It has been estimated that we are advancing our technological knowledge at the rate of 22% per year; our knowledge doubles every four years. This rapid technological change has carried us far beyond any historical experience with war, and has moved much too fast to be fully comprehended even by the most agile and fully-informed minds. From even casual study of history, we can see how fallible man is concerning war and how difficult it has been for him to adjust to new weapons. Yet compared to the changes we have to consider now, those of the past, when measured from one war to the next, were almost trivial. And almost always in the past, there was time after hostilities began for the significance of the technological changes to be learned and appreciated.[1]

What all this means, in aggregate, is that there is an obvious need for more creativity from our military management. We need more men who, instead of "going by the book" have learned to use their imaginations to solve our problems. This is especially important because a "book" suitable for the dynamic change years ahead of us has not yet been written.

This creativity must come from the top. Top and middle-management must set the example. If an officer does not himself have the inclination to become an "idea man", he must at least acquire enough knowledge and understanding of the creative processes so that he will not, inadvertently,

[1]Bernard Brodie, Strategy in the Missile Age (Princeton: Princeton University Press, 1959), pp. 407-408

block or discourage fresh and different kinds of thinking within his organization. Creative thinking should be encouraged to the extent that it is a means to an end. It is never an end in itself.

In this day of shrinking, or at best constant, budgets and manpower levels, it is clear that the Navy is encountering new problems at a much faster rate than it can provide additional personnel. Thus, it is apparent, that we must improve the capacity of our personnel to solve these problems. Moreover, without an improvement in problem-solving capability, it is unlikely that we can even maintain our present rate of productivity, for as the Queen said to Alice, " . . . here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"[2]

STATEMENT OF THE PROBLEM

The problem addressed by this study is: Can creative thinking be applied to problem-solving and decision making in the Navy?

OBJECTIVES

The objectives of this study are:

To determine the nature of creative thinking and how it relates to problem-solving and decision making.

To determine the nature of the Navy's need for creativity

To identify those actions which may be taken to apply creative thinking techniques and procedures to fulfill the Navy's needs.

[2]Lewis Carroll, Through the Looking-Glass and What Alice Found There (New York: The Heritage Press, 1941), p. 45.

ASSUMPTIONS

In pursuing this study, it is assumed that creative thinking in the Navy can be improved and that the management of the Navy desires such improvement.

PREMISES

Fundamentally, the theory of creative thinking is based on the following premises:

1. Everyone has some degree of creative ability.

2. Certain mental and social factors prevent people from fully utilizing their creative ability.

3. Through proper orientation, use of certain techniques, and through practice, these mental and social blocks can be eliminated and this innate creative capacity can be utilized to a greater extent. It is possible that the level of creative ability may even be raised somewhat by training.

LIMITATIONS

Limitations on this study are imposed by the nature of the objectives.

The investigation and analysis have been directed to the determination of main ideas which formulate a general viewpoint. Investigation of psychological and sociological areas has been limited to examination of factors which seem most directly related to the problem.

DEFINITION OF TERMS

Although the term "creativity" or "creative thinking" is widely used, there is no clear-cut, generally accepted, definition. Several definitions

will be examined, and an attempt made to synthesize a useful definition.

If one consults a dictionary issued prior to 1962, he will not find the term at all. Webster's Seventh New Collegiate Dictionary, the first desk size dictionary containing the term, defines creativity as the "ability to create."[3] Such a broad definition is clearly unsuitable for our purposes, since it would include the actor who creates (or recreates) a character on the stage as well as the Einstein whose creative abilities are responsible for many of today's world problems.

John E. Arnold, a leading advocate of creativity in the field of engineering, defines creativity as a process whereby past experiences are combined and re-combined, possibly with some distortion, in such a fashion that the new combination better solves some problem of mankind. The end result must be tangible, something you can see, feel, or react to. It must be forwardly oriented in time and it must have synergetic value.[4]

Another prominent writer provides a six-sided definition of creativity. His generic definition attempts to indicate the complementary nature of the various areas of creativity, and to reveal a spectrum of creative activity. The definitions provided by Mr. Repucci are:

[3]Webster's Seventh New Collegiate Dictionary, (Springfield, Mass.: G & C Merriam Company, 1963), p. 195.

[4]John E. Arnold, "What is Creativity," Creative Engineering Seminar 1959 (Stanford, Calif.: Stanford University, 1959), p. 10.

1. Perception or recognition of the interrelationship between ideas which make possible a "translation of knowledge and ideas into a new form".

2. Process which results in a novel work.

3. "Process of change, development, of evolution in the organization of subjective life" with emphasis upon self-expression and aesthetic values.

4. Process of interaction between the id, ego, and super ego.

5. Manipulation of the thinking process by stimulation of particular intellectual factors, i.e., discovery factors, divergent thinking factors, and etc.

6. Varia.[5]

Synectics, one of the techniques for inducing creativity, defines the creative process as the mental activity in problem-stating, problem-solving situations where artistic or technical inventions are the result.[6]

Another frequently cited definition of creativity is the capacity of translating the extrinsic into the intrinsic. This intrinsic view is a kind of seeing, and the true seeing of everyday things is a model of creative activity.[7]

[5]L. C. Repucci, "Definitions and Criteria of Creativity," paper read before the 1962 Utah Creativity Research Conference at the University of Utah, June 1962.

[6]William J. J. Gordan, Synectics (New York: Harper and Row, 1961), p. 33.

[7]Robert S. Hartman, "The Value Structure of Creativity," Creative Engineering Seminar, 1959, (Stanford: Stanford University, 1959), p. 23.

Before attempting to synthesize these various definitions into one short useful statement, it might be well to differentiate between creativity and originality. The measure of originality in a response is the uncommonness or rarity of its occurrence; the measure of creativeness is the value society places on it. Creative responses are thus original responses, but the reverse is not always true.[8]

Finally, let us examine some of the synonyms which help express the meaning of creativity. The most common of these are such words as imagination, inventiveness, ingeniousness, newness, and uniqueness. All these terms are to be found in the myriad definitions of creative thinking, although each individual definition may have some particular feature of its own.

All of the definitions cited have certain features in common. Each definition refers to new and valuable ideas, and to some action. Therefore, for the purposes of this paper, creativity is defined as: new and beneficial ideas put into action.[9]

The terms problem-solving and decision making are often used interchangeably. In order to prevent ambiguity, however, it is desirable here to distinguish between the two.

[8]Irving Maltzman, On the Training of Originality, Technical Report Number 5, Office of Naval Research Contract Nonr 233(50), (Los Angeles: University of California, August, 1959), p. 1, (mimeo).

[9]Joseph G. Mason, How to Be a More Creative Executive (New York: McGraw-Hill Book Company, 1960), p. 17.

Problem-solving is defined as: thinking activity directed toward reaching some goal; it generally involves thoughtful effort to get around or over some obstacle. Problem-solving is not the alternative, but well habituated response an individual makes to overcome an immediate obstacle.

Decision making is defined as: a course of action, chosen from the alternatives available, as the most effective means at the disposal of the decision maker for achieving the goal sought -- for solving the problem at hand.

The two processes, problem-solving and decision making are psychologically interwoven and it is not always possible to maintain the line of demarcation which has been attempted in these definitions.

CHAPTER II

THE NATURE OF CREATIVE THINKING

HISTORY OF CREATIVE THINKING

Creative thinking - thinking which produces new methods, new concepts, new understandings, new inventions - is the mainspring of human progress. With such impressive credentials, it would appear that the subject of creative thinking would long have been man's greatest interest. Unfortunately, this is not the case; the study of creative thinking is quite recent. Prior to 1950, very few people had studied the creative process. Almost no one believed that anything could be done to extend, enlarge, or improve man's power of creativity.

In 1950, Dr. J. P. Guilford, President of the American Psychological Association, commented in his inaugural address on the appalling neglect of such study. He observed that of approximately 121,000 titles listed in the index of the Psychological Abstracts since its origin 23 years before, only 186 were indexed as bearing on the subject of creativity. He added that only a few of them advanced the understanding or control of creative thinking very much.[1]

If we accept the thesis that creative thinking is the key to man's continued progress, why have we only recently commenced intensive studies of the creative process? The answer is simple -- we were not

[1] J. P. Guilford inaugural address to the American Psychological Association, September 5, 1950, published in The American Psychologist, Vol. V, No. 9, September, 1950.

aware that creative thinking is a universal quality. Despite man's centuries old interest in creative works, he has tended to regard creative ability as being peculiar to the genius; creativity has been associated almost solely with major achievements such as great inventions or masterpieces of art and theory. There was no meaningful evidence that creative thinking was a universal quality, hence no incentive to pursue the subject.

World War II brought forth large-scale proof of the creative potential of the masses. Millions of people, who had never considered themselves creative, brought forth ideas to assist with the war effort. In response to an appeal from the National Inventors Council, over 200,000 ideas were submitted for new inventions. The Ordnance Department alone estimated savings of over $50,000,000 in 1943 as a result of ideas submitted by rank and file employees.[2] The success of the suggestion systems during this wartime period stimulated the interest of management, and with the demonstrated value of a system devised to tap the creative potential of the individual as a model, suggestion systems in industry soared in popularity.

Research psychologists and sociologists, noting the experience of industry and responding to the expressed needs of society to utilize its creative resources, began to conduct systematized research in the area. They were early able to describe and confirm universality as a basic

[2]Alex F. Osborn, Applied Imagination (New York: Charles Scribner's Sons, 1953), p. 57.

characteristic of creative thinking. Maslow termed creative thinking as a heritage of every human, "a common and universal kind of thing."[3] Maslow's findings are confirmed by almost all studies concerning the distribution of creative talent. The Human Engineering Laboratories of Stevens Institute of Technology, under the direction of Dr. Johnson O'Conner, analyzed the talents of large groups of employees, and came to the conclusion that creative talent is normally distributed -- that all of us possess this talent to a greater or lesser degree -- and that our creative efficacy varies more in ratio to our output of mental energy than in ratio to our inborn talent.[4]

THE NATURE OF THE CREATIVE PROCESS

The study of the creative process is encumbered by the fact that it is not a single act, but a process and is, therefore, in motion. Traditionally, (and of necessity), creative processes have been considered after the fact -- that is, halted for observation. Although studies have attempted to research the creative process *in vivo*, none of them has, so far, been very successful. Therefore, the only way to learn about the process is to try to determine what steps underlie the surface phenomena of creativity.

[3]A. H. Maslow, "Emotional Blocks to Creativity," a speech given at the Creative Engineering Seminar, U. S. Army Engineer School, Fort Belvoir, Virginia, April 24, 1958, reprinted in Creative Engineering Seminar, 1959 (Stanford: Stanford University, 1959).

[4]Osborn, op. cit., p. 56.

Research into the thinking process itself has long since established a generally accepted sequence of phases which creative thinking follows. Graham Wallas, as early as 1926, identified four phases which he called: preparation, incubation, illumination, and verification.[5] His analysis has been supported by subsequent investigations into creative ability in the fields of art, literature, and science. These investigations have indicated that when one or another of these phases is lacking or inhibited, creativity suffers; when a weak phase is stimulated or developed, creativity improves.

Today's psychologists have added one additional step to Wallas' original list, namely problem recognition. Thus, it is generally agreed, the creative process involves five fundamental steps:

1. Problem recognition. The creative person must first be able to sense a problem; that is he must be able to recognize some area toward which his creative effort may be directed. In some cases the problem is quite obvious; in others it is subtle and requires great sensitivity on the part of the individual. It may be the sensing of something which is out of order in an otherwise orderly collection of data. It may be the recognition of inadequate support for an established action, or lack of explanation for an unexpected event. Whatever the sensation, it seems to be one easily affected by the emotional environment in which the individual works as well as by the amount and type of information to which he has access.

[5] Graham Wallas, The Art of Thought (New York: Harcourt-Brace, 1926).

2. Gathering of pertinent data. In the second step, the individual assembles in his mind pertinent data concerning the problem. He may recall past experiences and also study new material. A creative idea is not a simple rehashing or rearranging of ideas already known to the conscious mind; it is an entirely new and different thing which comes forth from the subconscious mind as a result of the conscious mind's concentration on known ideas related to the problem. The role of preparation is that of supplying the mind with the necessary collection of information which can be sorted, rearranged, and brought into association to suggest a new hypothesis or solution.

The manner in which the information is stored, as well as the amount of it, is important. It is better if the pieces of information are stored as part of an associated body of ideas, not as single units. By having access to and understanding of the widest possible field of knowledge associated with his own area of activity, an individual is able to develop a maximum number of cross references. This affords a greater possibility of recall at a later time when the items are essential in an association with other material to give birth to a new and different idea.

3. Incubation. This term is applied to the subconscious activity which precedes an insight or inspiration. Very little is actually known of this process, but it is assumed to exist because so much insight appears never to have passed through the process of conscious development.

To better understand incubation, the conscious and subconscious minds must be examined. The conscious mind is the center of logical thinking and deals with known ideas, but does not seem to create ideas of its own. Conversely, the subconscious mind directs itself to problems which are of interest to the conscious, yet the individual is unaware of its activity until a new idea is created and submitted to the conscious.

Since the output of the subconscious is different from the input, and is not even the sum of inputs, it seems reasonable to assume that a new idea is created in the subconscious after considerable sorting and manipulation of the information stored therein. When a suitable combination is found, which may take an instant or several years, it is presented to the conscious in the form of inspiration or illumination as a solution to the problem.

4. Illumination. The point at which the solution appears to the thinker is called illumination, or inspiration. Several solutions may be presented to the conscious mind during incubation. These may be rejected, sent back for further consideration, or retained for study and verification.

As the conscious mind grapples with the problem, it dominates the subconscious and directs it along the narrow lines of conscious thinking. Although the subconscious may produce during this time, it is most likely to be creative when the conscious mind, after concentration on the problem, is relaxed and not occupied with the matter. During this time the subconscious does not relax, but ranges freely through the stored data,

sorting and rearranging until a solution is suggested and presented to the conscious as illumination.

Evidence is found of this process in many inspirations which, after a period of concentrated effort, have come to relaxed individuals. This happens so often, and the inspiration is frequently so fleeting and elusive, that some creative individuals attempting to solve great problems carry paper and pencil at all times in order to make notes to assist the conscious mind in recall.

5. Verification. During the process of verification, the mind sets about by logical method or experimentation, to prove (or disprove) the solution suggested. This process is essential to creative thought, but it is necessary to maintain an open mind so as to avoid rejecting an idea because of previously conditioned thought processes or attitudes. This is actually a most crucial phase of creative thinking, since new ideas are worthless until available for consideration by those who can use them.[6]

As the foregoing discussion indicates, the creative process involves a great deal of hard work. Even though a moment of inspiration or illumination can occur, it is the final integration of elements and details which

[6]Roger Bellows, et al. (editors), Executive Skills Their Dynamics and Development (Englewood Cliffs: Prentice-Hall, Inc., 1962), pp. 294-295.; Timothy W. Costello, op. cit. pp. 340-342.; James C. Coleman, Personality Dynamics and Effective Behavior (Palo Alto: Scott, Foresman and Company, 1960), pp. 390-391.; Osborn, op. cit., pp. 120-181.

have been assembled. A lifetime of study and thought may prepare the way for the sudden flash of insight. "No great thing is created suddenly, any more than a bunch of grapes or a fig." Epictetus.

CHARACTERISTICS OF CREATIVE PEOPLE

In considering creativity as an individual phenomenon, many psychologists have concentrated on the development of tests which demonstrate a statistical relationship to measures of creative performance. In some cases, inferences have been drawn from the statistical interrelationships of tests designed to measure psychological dimensions hypothesized to be important factors in creativity. Other psychologists have emphasized study of the creative personality, and have attempted to identify traits which are characteristic of highly creative people. Still others have attempted to identify and describe the various stages of mental activity involved in the creative activity.

Probably the most extensive research in developing tests of creative ability has been conducted by J. P. Guilford at the University of Southern California under contract with the Office of Naval Research. The major portion of the research has consisted of statistical studies of mental abilities employing factor-analytic techniques. Guilford hypothesized a number of creativity factors dealing with primary abilities, to which he has given the following names:

Sensitivity to problems
Ideation fluency
Flexibility of set

Ideation novelty
Synthesizing ability
Analyzing ability
Reorganizing or redefining ability
Span of ideational structure
Evaluating ability.

Guilford's approach has been to develop a large battery of tests designed to measure the hypothesized creative ability factors. These tests are then given to a group of subjects and the results are statistically analyzed to determine their validity. The researchers have had considerable success in isolating factors of creative ability. This is not too surprising, however, since the tests were constructed to measure the hypothesized factors. Essentially, they have gotten out of the tests what went into them. The analysis has served to identify additional factors and to clarify the nature of the test battery. Guilford feels that it is possible to measure individual differences in creativity through the use of psychological testing.

Unofrtunately, efforts to transfer the tests from the laboratory to an industrial setting, and to relate them to external measures of creativity have not been very successful. The results do show sufficient promise, however, to indicate that additional effort is warranted.[7]

[7]J. P. Guilford, "Intellectual Resources and Their Values as Seen by Scientists," Scientific Creativity: Its Recognition and Development, C. W. Taylor and Frank Barron, editors (New York: John Wiley and Sons, Inc., 1963), pp. 101-118; J. P. Guilford, "The Psychology of Thinking, Creative Engineering Seminar, 1959, (Stanford: Stanford University, 1959), pp. 1-21); J. P. Guilford, R. C. Wilson, P. R. Christen, and D. J. Lewis, "A Factor-Analytic Study of Creative Thinking:" "I. Hypothesis and Description of Tests," (No. 4, 1951), and "II. Administration of Tests and Analysis of Results." (No. 8, 1952). Reports From The Psychological Laboratory (Los Angeles: University of Southern California).

At about the same time that Dr. Guilford was trying to determine some valid measure of creativity among engineers and scientific personnel, Dr. Viktor Lowenfeld at Pennsylvania State University was conducting similar research using artists and art students as subjects. The criteria for creativity developed at Penn State were: flexibility; fluency; sensitivity to problems; originality; and the ability to analyze, synthesize, and redefine materials and problems, and organize them coherently.

Although these two studies were conducted independently of each other and used entirely different types of subjects, they arrived at remarkably similar conclusions. In fact, it is noted that the same names were even used in several instances by each group.[8]

Although the data available are too limited to draw a conclusion, it is interesting to speculate upon the findings. It appears that the elements or factors which are found in creative individuals are essentially the same without regard to the individual s field of endeavor. Dr. Kenneth R. Beittel, of Pennsylvania State University, and Dr. W. Lambert Brittain, of Cornell University, are conducting further research in an effort to validate this theory.

The attributes of creativity mentioned hereinbefore have been called the "keys to creativity" and their measurement the "capture of

[8]Viktor Lowenfeld, "Creativity: Eduation's Stepchild," Sidney J. Parnes and H. F. Harding (editors), A Source Book for Creative Thinking (New York: Charles Scribner's Sons, 1962), pp. 9-17.

the elusive quality of mind and spirit that is responsible for all real progress in business, technology, and the arts and sciences."[9] The tremendous importance of these attributes stems from the fact that they can be learned and practiced.[10] Unfortunately, many organizations will have great difficulty teaching them. The degree of difficulty should correlate with the absoluteness which management displays in expressing its views on objectivity, and adherence to generally accepted management principles and logic.[11]

Since this is so, it may be desirable to elaborate on these primary attributes.

Sensitivity to problems - an unusual sensitivity to what is seen, heard, touched, etc. The ability to observe as well as see, to listen as well as hear, to feel as well as touch. It requires permeability in concepts, beliefs, and perceptions, as well as a lack of rigidity. It requires a high tolerance for ambiguity and unexplained events.[12]

[9] "Eight Keys to Creativity," Nation's Business, Vol. 49, No. 2 February, 1959, p. 58.

[10] Alex F. Osborn, "Developments in Creative Education," Parnes and Harding, op. cit., p. 22.

[11] "Can Decision Making be Learned?", Navy Management Review, Vol. 5, No. 8, August, 1960, p. 3.; Marshall E. Dimock, Administrative Vitality (New York: Harper and Brothers, 1959), pp. 76-101.

[12] Carl Rogers, "Toward a Theory of Creativity," Parnes and Harding, op. cit., p. 87.

Fluency can be broadly defined as the facility with which ideas can be generated. Closely related to fluency is flexibility - or the ability to adjust quickly to new and changing situations. Together, these two attributes can be considered as measures of problem sensitivity in action. There is also some indication that fluency and flexibility are the intellectual catalysts which control the contribution which knowledge and experience (IQ) can make to creative output. Research results have consistently ruled out IQ scores as predictors of creative potential; the same research, however, has empirically demonstrated that, although a high IQ does not indicate a high creative potential, a high creative potential does generally indicate a high IQ.[13]

Although in the definition of creativity an effort has been made to distinguish between creativity and originality, it will be recalled that originality is an attribute of the creative individual. It seems obvious that the highly creative individual will have more original ideas (novel combinations) than the less creative, consistently bringing together seemingly disparate ideas or objects to form new and useful combinations. Originality, at this level, is dependent on fluency and flexibility. That is to say, the number of good ideas produced varies directly with the total number developed.

[13]John R. Hinrichs, Creativity in Industrial Scientific Research (New York: American Management Association, 1961), p. 16.; Donald W. MacKinnon, "What Makes a Person Creative?", T. W. Costello and S. S. Zalkind, Psychology in Administration (Englewood Cliffs: Prentice-Hall, 1963), pp. 417-421.; J. P. Guilford, "Creativity: Its Measurement and Development," Parnes and Harding, op. cit., p. 163.

Analytical ability and a sense of organization are major attributes of the creative individual. Frequently, management problems are recognized and stated in terms of variables within the control of the organization and in a form appropriate to the level in the hierarchy at which perceived. The problem-solver must have the ability to abstract these problem elements and restate the problem in terms which will form a base for an effective attack.[14] Problem definition, which is the product of analysis and organization, is so important in directing and maintaining creative output that William J. J. Gordan has coined the term "problem-stating, problem-solving" to describe the scope of his Synectics theory of operational creativity.[15] Highly creative individuals learn readily to analyze differences in people as well as in inanimate objects and to synthesize information. Borrowing a phrase from Gestalt psychology, analytical ability may be defined as the ability to redefine things; to transform the meaning or use or function of an object so as to give it a new role.

The attribute of synthesis is defined simply as the ability meaningfully to combine several elements to make something new.

This discussion of the attributes of creativity will be summarized by discussing those attributes considered essential to creativity by Dr. Carl Rogers. It will be noted that these attributes, although

[14]James G. March and Herbert A. Simon. Organizations (New York: John Wiley and Sons, Inc., 1958), pp. 79-80.

[15]William J. J. Gordon, Synectics (New York: Harper and Row, 1961), p. 3.

identified in somewhat different terms, are essentially those discussed above. According to Dr. Rogers, the creative person must first develop an openness to experience, not only to all external environmental events, but to changes that take place within himself as well. He must develop a questioning attitude and have the ability to make wide associations. He must develop an internal locus for evaluation -- he must resist outside pressure to conform. And finally, the creative person must like to toy with ideas and concepts; he must not be afraid of fantasy.[16]

BLOCKS TO CREATIVITY

Just because an individual has highly developed potential for creative activity, is able to analyze, synthesize, and evaluate, and has the necessary initiative to complete his novel ideas, we cannot assume that he will function creatively. It is entirely possible for such an individual to find himself in situations where it is impossible to work effectively. The factors which tend to inhibit and prevent creative activity are called blocks.

Blocking characteristics may be divided into three main classifications: perceptual, cultural, and emotional. Perceptual blocks are all those things that keep an individual from getting an adequate picture of the outside world in which he must operate. The cultural blocks encompass all of society's effects upon the individual. The emotional blocks are

[16]Carl Rogers, "Toward a Theory of Creativity," Parnes and Harding, op. cit., pp. 63-72.

perhaps the most complex and difficult to understand. Emotional blocks are set up by the individual as a result of his fears, anxieties, and jealousies.[17]

TECHNIQUES OF CREATIVE THINKING

Studies of the creative process and of the characteristics of creative people have not produced empirical data which can be used to answer the question: "What makes a man creative?" Is it something in his education, his up-bringing, his physical makeup? Or was it his schooling, or the books he read, or his intelligence? Actually, all these factors may have some bearing on an individual's creative ability. The studies of what makes a person creative are far from complete; but the preliminary findings, from independently conducted studies, are so closely in agreement that it has been possible to develop techniques and procedures to facilitate the ideation process in individuals and groups. These methods generally reduce to procedural form rules and lists of questions for guidance of the creative mental processes. In 1961, J. W. Taylor described eleven different proven techniques for improvement of creative thinking.[18] All these techniques are in widespread use today; each will be discussed briefly.

[17]John E. Arnold, "Factors Influencing Creativity," Creative Engineering Seminars, 1956. (Cambridge, Mass.: Massachusetts Institute of Technology, 1956) pp. 16-21.; A. H. Maslow, "Emotional Blocks to Creativity," Parnes and Harding, op. cit., pp. 93-103; Melvin Tumin, "Obstacles to Creativity," Parnes and Harding, op. cit., pp. 105-113.

[18]J. W. Taylor, How to Create New Ideas (Englewood Cliffs: Prentice-Hall, Inc., 1961).

TECHNIQUES OF CREATIVITY

The Checklist Technique

A very easy and effective way of developing the questioning habit is to use some form of checklist. Dr. G. Polya developed a checklist for guidance in solving single answer mathematical problems which, with slight modification, can be applied to multi-answer creative problems. Use of this check list, contained in Appendix A, exercises questioning, fluency, flexibility, and originality through increased observations and association.[19]

A second example of a very effective check list is one prepared by Alex Osborn and contained in Appendix B.[20]

Many other examples of check lists can be found or devised. They may be made up to apply to a specific problem, or they may apply to a general class of problems. Since the method of application of a check list is generally known, it will not be further discussed.

The Attribute Listing Technique

Attribute listing is a technique used principally for improving tangible things. Developed by Professor R. P. Crawford at the University of Nebraska, it consists basically of listing all the attributes or qualities of an object or problem, then systematically considering

[19]G. Polya, How To Solve IT (Princeton: Princeton University Press, 1945), inside front cover.

[20]Alex Osborn, Applied Imagination, op. cit., p. 284.

each attribute or group of attributes in turn, trying to change them in as many ways as possible. An example demonstrating the technique is appended as Appendix C.

The Input-Output Technique

Input-output technique has its principal use in dynamic system design problems involving energy. A dynamic system can be classified according to its input, output, and limiting requirements or specifications. Once the problem has been defined in these terms, some means of making the input produce the desired output within the specified limitation is sought. The objective is to produce a number of possible solutions for evaluation.

For most purposes, either attribute listing or the input-output techniques are probably more effective than check-lists because they are based upon an individual analysis of the product or problem in question, rather than on an historical accumulation of checkpoints. However, the two techniques are not particularly suited to the same types of problem. Attribute listing is generally more effective when attempting to change or modify an existing object or procedure because it concentrated on the attributes of the object in question. The input-output technique, on the other hand, concentrates on the job to be done, and thus is probably best suited for seeking new or alternative ways to accomplish the same objective.[21]

[21]C. S. Whiting, "Operational Techniques of Creative Thinking," Max D. Richards, and W. A. Nielander (editors) Readings in Management (San Francisco: South-Western Publishing Company, 1958), pp. 236-249.

The Edisonian Technique

The Edisonian or empirical approach consists mainly of an endless number of trial and error experiments. Edison's name is given to this technique because he frequently used this method in arriving at solutions to his problems The controlled empirical series of approaches includes the majority of industrial and governmental research and development activity. Trial-and-error must be utilized at times, but a lot of wasted motion and effort can be prevented by a more thoughtful approach to the problem solving situation. .

The Edisonian approach should only be employed when other more systematic methods have failed to produce the desired result, or when one is delving into unknown areas of pure basic research.

The Catalog Technique

Users of this technique simply reference various and sundry catalogues as a means of getting ideas that will in turn suggest other ideas. This is a favorite method of cartoonists who take a Sears Roebuck catalogue or other source containing a large variety of objects, select two or more at random and force a relationship between them. The relationship is then used for a cartoon idea.

The Free Association Technique

This is a method of stimulating the imagination to some constructive purpose. One procedure is to jot down a symbol, sketch, or number, which is in some way related to an important aspect of the problem or subject under consideration. Then, letting yourself play with ideas,

letting them come out in profusion, jot down another symbol, continuing until a quantity of intangible ideas have been produced. The object of this technique generally is to produce advertising slogans, names, designs, and similar objects.

The Forced Relationship Technique

This technique has essentially the same basic purpose as free association. The procedure is to make a list of the elements of the problem or ideas related to the problem. These elements may or may not have some relationship to each other. The list is then numbered and the first item on the list is considered in relationship with each other item in order. Item two is treated in the same manner and so on until all items have been considered in relationship to every other item. A variation is to consider three or more items together. The patterns which develop from these forced relationships are then used to develop new ideas.

Experience has shown that this technique is not particularly suitable for solving an existing problem except in the broadest sense. It is extremely useful, however, in literary fields where the user is often only seeking a new and different idea rather than the solution to a specific problem.

The Morphological Analysis Technique

Morphological analysis is a comprehensive way to list and examine all the possible combinations that might be useful in solving some given problem. The procedure is as follows: the problem is stated broadly, and then all the independent variables are broadly and generally defined.

Each independent variable becomes an axis on the morphological chart; if there are "n" variables, the chart has "n" dimensions. Each of the independent variables can probably be expressed in more than one way, and each is laid out as a unit on one of the "n" axis. A sample three dimension chart is shown in Appendix D. For more than three dimensions, a permutation listing is more practical than a chart.

This three dimensional chart can easily be visualized as a file cabinet containing 224 drawers. On opening these drawers, we will find that some are filled with already invented transportation devices; the majority will be empty, however. Some are empty because the combinations represented are absurd; but some will be empty because no one has thought to combine the variables in just this fashion.

While attribute listing and morphological listing seem quite similar, they have a fundamental difference. Attribute listing is usually, and most effectively, applied to specific problems. On the other hand, morphological analysis is applied to a basic, all inclusive, generic problem.[22]

The Big Dream Technique

The procedure for utilizing the big dream technique is simple -- think up the biggest dream possible about something of benefit to mankind. Then read, study, and think about every subject connected with the big dream, and do so regularly, persistently, and continually. If

[22]John E. Arnold, "Useful Creative Techniques," Creative Engineering Seminar, 1959 (Stanford: Stanford University, 1959), pp. 7-11.

forced, drop down a dream or two, then engineer the dream into reality.

The previously listed techniques can be very useful in piling up alternative solutions for the big dream.

The Brainstorming Technique

Probably no technique of creative thinking has been so widely publicized, acclaimed, used, abused, misunderstood, and damned as brainstorming.

Brainstorming was started in 1939 as a special technique in the prominent advertising agency of Batton, Barton, Durstine, and Osborn, Inc., where its primary use was on promotional problems. The name itself is probably an unfortunate choice suggesting as it does a "flash-in-the-pan" approach. However, it is not important that the technique is called brainstorming, or that it originated in the advertising field; what is important is that it is a proven, useful, and productive technique when used properly.

A brainstorming session has only one purpose - to produce ideas. It is not a problem solving or decision making process, nor is it a substitute for the individual approach to problem solving. Much of the misunderstanding about brainstorming stems from lack of understanding of its aims or from efforts to apply it to the wrong type of problems.

Brainstorming is a three-step procedure: preparation, including orienting the problem and selecting the panel members; the session itself; and the follow-up to the session when ideas are screened and evaluated.

The chief cause of failure to obtain usable ideas from a brainstorming session is attempting to apply the technique to the wrong type problem. As noted, the purpose of brainstorming to produce a large quantity of alternative ideas; therefore, the problem must be one that lends itself to many possible approaches. The problem should not require value judgments because brainstorming is not a decision making technique. The problem selected should be fairly specific; if it is large and complex, it should be broken down into several separate problems.

Once the problem is defined suitably, the members of the panel should be selected. It is not necessary that the panel members be "experts"; in fact, "experts" frequently inhibit ideation by other panel members. Generally, experience has indicated, the panel should contain between five and fifteen members, with six to eight being the preferred. If possible, one or two "self-starters" should be included. All members should be of approximately the same status and income level - that is, no "brass".

About 48 hours before the session, each member of the panel should be advised of the problem in order to give him an opportunity to "incubate" prior to the meeting.

The actual session should be conducted in accordance with the four basic rules of brainstorming:

a. Criticism is ruled out. Judgments of ideas must be withheld until later.

b. "Free Wheeling" is welcomed. The wilder the ideas the better; it is easier to "tame down than to think up." Off-beat ideas may trigger practical ideas from another member of the panel.

c. Quantity is needed. The greater the number of ideas, the more the likelihood of good ones. This is the basic aim of brainstorming - to generate such a quantity of ideas that there is almost a mathematical certainty of finding at least one good one.

d. Combinations and improvements are sought. Suggestions by others on an idea give better ideas. Combinations of ideas lead to more and better alternatives. Synthesis, combinations, mutations, and other idea-mixing forms are the basic methods for producing new ideas.

The chairman of the session is the key person; it is his responsibility to get ideas from members and to see that each member takes part. He should have some audible signal to warn anyone who forgets himself and attempts to introduce judgment into the session.

All ideas produced during the session must be recorded. This can be done with a tape recorder, or by a secretary. It will probably be necessary to have two secretaries in order to get the ideas down if the session is a fast moving one The notes can be taken reportorially, rather than verbatim.

The length of a brainstorming session should be 45 to 90 minutes. The minimum time ensures that the session does not die when the common ideas are out of the way and forces panel members to produce something new. The maximum length is established by the fatigue point.

As indicated in the foregoing, brainstorming is a simple procedure. In reality, it is merely a group of people presenting ideas without evaluation. The whole session should be relaxed and friendly.

After the session, members are invited to submit any additional ideas they may have; the proceedings are then typed and each participant is given a copy. After a short period - usually two or three days - the panel is reconvened to evaluate the ideas produced and select those which seem to be the most applicable to the problem. These ideas are then given to the individual who submitted the problem as suggestions for a solution. This individual must decide what action he will take and which of the alternatives available will be selected for implementation or further study.[23]

Although brainstorming has been, for twenty years, referred to only as a method of group ideation, it means much more. It can be considered a principle which is just as applicable to solo effort as it is to team effort. The essence of the matter is that one can think up more useful leads to the solution of the problem if he deliberately defers judgment during his idea finding efforts. He simply does not allow his critical thinking to impede his creative thinking during this stage of creative thought. In other words, to promote ideational behavior, one consciously becomes less inhibited. Later, judgment is applied to weed out the irrelevant from the relevant.

[23]Mason, op. cit., pp. 167-176; Roger Bellows, et al., Executive Skills (Englewood Cliffs: Prentice-Hall, Inc., 1962), pp. 298-303.; Arnold "Useful Creative Techniques," op. cit., pp. 63-70.; Osborn, op. cit., pp. 297-307.

There are, in fact, studies which indicate that individual brainstorming is more effective than group brainstorming. That is, five individuals applying the principles of brainstorming separately will produce more ideas than the same five individuals working in a group.[24]

The Synectics Technique

Synectics, from the Greek, means the joining together of different and apparently irrelevant elements. It is an operational theory for the conscious use of the preconscious psychological mechanisms present in man's creative activity, developed by William J. J. Gordan of the Arthur D. Little Company. This technique is better known under the name, "Operational Creativity" although it is sometimes referred to as the "Gordon Technique" after its developer.

Synectics is the basic method used by the Arthur D. Little Company's Design Synthesis Group which has as its job, the invention of new products to order for their clients. They claim that, so far, they have never failed to produce a requested invention.

Although the basic technique of Synectics seems to be the same as brainstorming, in reality it is quite different. In the synectics technique, only one radically new idea is wanted; it is a problem-solving, as opposed to an idea generating, technique.

[24]Donald W. Taylor, et. al., "Does Group Participation When Using Brainstorming Facilitate or Inhibit Creative Thinking?" Technical Report 1, prepared under Contract Nonr 609(20) for the Office of Naval Research, (New Haven: Yale Department of Psychology, November, 1957.)

The principal characteristic of the synectics session is that only the group leader knows the exact nature of the problem to be considered. There are two main reasons why Gordan feels that the other panel members should not know what the problem is: first, he feels that brainstorming produces superficial ideas, and secondly, he seeks to avoid egocentric involvement, or infatuation with one's own ideas.

Because the group members do not know the exact problem being considered, it is extremely important to choose a subject that is suitable - i.e., one that is actually related to the real problem, but does not reveal its specific nature. For example, Mr. Gordan has used these as subjects: for a new toy, "play"; for a fishing lure, "persuasion"; for a new can opener, "opening". Utilizing some such subject, the group begins to discuss it with enough guidance from the leader to keep them from going completely astray. When the leader feels that the group has either exhausted the possible aspects of the problem or that the group has produced a particularly good idea worth examining in more detail, he reveals the exact nature of the problem. The group then channelizes its efforts into synthesizing the previous exploratory and speculative thinking toward solving the real problem. After a promising idea is obtained, the project is turned over to an engineering group for development of the finished product by conventional means. The exceeding influence of the leader of a Synectics group on its success is patently obvious.

Mr. Gordan has made the following suggestions to persons attempting to apply this technique:

a. Session lengths should run a minimum of two - three hours.

b. The group leader should be exceptionally gifted in group dynamics and thoroughly trained in the use of the technique.

c. The group members should have diverse backgrounds, with varied activity levels, be in the 25-40 age bracket, and be in generally the same income bracket.

d. Have both a secretary and a tape recorder to take down the discussion.

Synectics' avoidance of preconceived ideas and ego involvement offers some distinct possibilities for improving creative exploration of a problem area. The broad initial problem statement acts as a spur to complete flexibility.

Although use of this technique has been limited so far to problems of design and of a technical nature, it seems to have definite applications in other fields, including management. One, so far, unexplored use of Synectics is in combination with other group techniques to overcome the shortcomings of each.[25]

General

It must not be presumed from the foregoing descriptions of creative techniques that each is separate and distinct from the other. Probably the greatest potential for the utilization of the various techniques is in the intelligent adaptation and combination of the various methods Not only is it possible, but it is highly desirable and productive to

[25]Gordan, op. cit., pp. 1-57.

utilize many techniques on the same problem. Prior to group sessions, a participant should utilize one of the individual techniques in order to prepare himself, and following such a session should again apply an individual technique to ensure that he has gained every possible new idea.

Modifications of the various techniques often prove particularly beneficial. For example, the Hotpoint Company has developed a modification of the brainstorming technique which they call "reverse brainstorming." In operation, a product, problem or system is assigned to a group. One person from the group utilizes various techniques to find everything he can that is wrong with it. In the group meeting, he takes each of the flaws and presents at least one suggestion for improving it. The rest of the group brainstorm improvements on his and all other suggestions. The result is usually a list of highly refined ideas. In one instance, such a group was able to take a planned $200,000 conveyer system and come up with a new design that was installed and worked successfully for $4,000.[26]

Another modification which has found wide application is called "stop and go brainstorming." This method combines good features of brainstorming and Synectics by having a more or less set procedure, comparable to the agenda of a conventional meeting. It still requires a leader, but eliminates the absolute dependence upon a strong leader found in Synectics.

[26]J. G. Mason, How to be a More Creative Executive (New York: McGraw-Hill, 1960), pp. 181-182.

CHAPTER III

APPLIED CREATIVITY

The principles and procedures discussed in Chapter 2 have been extensively applied in industry, in education, and in the military services. In this chapter several of the more prominent applications in each field will be examined. The programs which will be discussed were chosen first because of their well established, time tested reputation and second, because there has been a significant amount of literature published concerning them.

INDUSTRIAL PROGRAMS

One of the best known, and almost certainly the oldest formal teaching program in creativity is the one conducted by General Electric which was organized in 1937 under the direction of Dr. A. R. Stevenson.[1] An original objective of the program was to work out a purposeful, logical plan which would enable top management to discover and develop creative talent in its engineers. Prior to the beginning of the formal program, young engineers who showed creative promise were associated purposely with some Senior Engineer. The Senior Engineer was to nuture, guide, and encourage the creative spark in his "apprentice." This technique, although excellent in many respects, was too random and loosely controlled. Hence a formal program was developed.

[1]George I. Samstad, "General Electric's Creative Courses," A Source Book for Creative Thinking, Sidney J. Parnes and Harold F. Harding, editors (New York: Charles Scribner's Sons, 1962), p. 334.

In the early years, the course was only one year in length. By 1947, however, the course administrators more clearly recognized and understood the type of philosophy which had to be imparted in order to enhance and develop the participants' ability to do creative work. Since the acceptance of a philosophy is a function of time and experience, a lengthening of the course was necessary to obtain full potential from its use.[2]

In its present form, the program is two years in length. The first year, Creative Course I, is devoted to creative philosophy, problem approach, and application, while the second year, Creative Course II, is devoted to evaluation and reduction of ideas to practice.[3] Throughout the course, the student is placed in an atmosphere where he must "live by his wits". Scheduled invention becomes commonplace; radical innovations are encouraged.[4]

Results of the program have been most encouraging. Graduates of the course have, on the average, three times as many patents to their credit as the non-graduate engineers.[5] Although there can be

[2]Ibid., p. 335.

[3]Robert E. Chestnutt, "Creative Courses at General Electric", from a speech at the Military Creative Problem Solving Seminar, March 1961, at U. S. Army Management School, Ft. Belvoir, Va.

[4]Samstad, op. cit., p. 335.

[5]Ibid., p. 333.

no doubt that the initial selection process plays a big part in accounting for the outstanding performance of these engineers, General Electric feels that the program contributes significantly. In recognition of this, a 16 week management course has recently been organized as well as a 10 week course in creative sales for sales promotion and advertising personnel.[6]

The management of General Electric feels that the full potential of the long course graduate is not realized for some years and the extent of his ultimate contribution depends upon a stimulating atmosphere, encouragement, and the opportunity to apply his abilities.[7]

Fange, for many years director of the creative engineering course and author of the course text, states: "A receptive environment is essential if a free flow of new ideas is desired."[8]

"The business enterprise that establishes a conducive atmosphere, so that anyone with any motivation at all will be stimulated and encouraged to take time to improve himself, his product, and his company, will be setting the pace in the race for product leadership." (underscoring supplied)[9]

What has grown into probably the largest creativity program in industry started in September 1953, when a group of distinguished men

[6]Chestnutt, loc. cit.

[7]Samstad, op. cit., p. 339.

[8]Eugene K. Von Fange, Professional Creativity, (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1959), p. 78.

[9]Ibid., p. 87.

of science, education, and industry met at the AC Spark Plug Division of General Motors for the purpose of discussing creativity. This was the formal beginning of the extensive program of research and development in the area of creativity in which the AC Spark Plug Division has since been engaged. The research has been both basic and applied.[10] The discussion hereinafter will be restricted to the applied phases.

The first formal training was conducted by the late Professor John Arnold, then of M.I.T., who presented his course in Creative Engineering to the Management staff of AC Spark Plug. The course was so enthusiastically received that the decision was made to introduce the course in the Management Development Program. Professor Arnold, accordingly, trained twelve "in-house" instructors who each trained fifteen persons in the spring of 1954; several thousand employees have now completed the course.[11]

In addition to the formal training, it was deemed vital to modify certain attitudes and to distribute creative individuals so that each section would have its needed share. Before this could be done, however, it was necessary to identify those who were relatively high in creativity. Assisted by technical consultants, AC devised a "paper and pencil" test which sought to measure creativity by measuring fluency,

[10]A. L. Simberg, "Four Years of Creativity at AC," (Flint, Mich.: AC Spark Plug Division, General Motors Corporation, 1957), p. i. (Mimeographed.)

[11]Ibid., p. 7.

flexibility, novelty, and sensitivity to problems. These tests were given to all personnel and carefully validated by comparing the results with evaluations by supervisors. Based upon these considerations, individuals were assigned to jobs which would permit fuller utilization of their indicated creativity potential.

The final step was to encourage the type of supervision that would enable the employee to use his creative ability to the maximum. This creative atmosphere was achieved by a combination of top level interest and the comprehensive training program described above.[12]

Has the program paid off? One of the difficulties of evaluating a program such as this is the post hoc, ergo propter hoc fallacy. There is no clear certainty that a cause and effect relationship has been identified. Taking into account these imponderables, AC is well pleased with their results and have some rather impressive evidence to support their pleasure.

For example, in the area of employee suggestions, this was the trend during the first three years of the program:

	Year	Total Suggestions	Suggestions Accepted
	1952	4,424	1,174
Program started	1953	9,319	2,174
	1954	13,690	4,079
	1955	17,782	6,158

These figures are based on a total work force of about 11,000 hourly employees.

[12] "Planned Creativity Pays Off," Nation's Business, Vol. 45, No. 1 (January 1957), p. 34.

A similar pattern of high idea production was evident among the group of approximately 500 supervisors. In 1956 supervisors submitted 437 ideas; 256 were adopted at an estimated saving to the company of over $500,000.[13]

In 1959, in an effort to obtain a more precise evaluation of their creative training, AC conducted a series of controlled experiments. Two groups of non-supervisory personnel were selected for special training; group A -- 18 people with high suggestion records; group B -- 13 people with low suggestion records. The plant as a whole was used as the control group (group C).

Groups A and B attended 10 one-hour training sessions. Records of suggestions submitted by both groups for one year before the training and one year after the training were compared on the basis of three criteria:

1. Number of suggestions submitted
2. Number of suggestions accepted
3. Amount of money awarded for accepted ideas.

The record shows that group A submitted 40.5% more suggestions after training; group B submitted 46.8% more; the control group submitted 3.7% less. Suggestions accepted -- group A up 18%; group B no change; group C down 11%. For the worker, however, the real payoff was in the amount awarded for accepted suggestions. Group A's awards went up 111%; group B's up 138%; the control group gained only 18%. In order to appreciate the absolute value to the individual of the training, the

[13] Ibid.

dollar amounts of awards are compared:

Group	Before Training	After Training
A	$39.53	$83.30
B	33.33	79.30
C	19.94	23.46[14]

The company is convinced that the testing and training program is paying off. Mr. A. L. Simberg, General Supervisor of Training, speaking before the Second Military Creative Problem Solving Seminar at Fort Belvoir in 1962 said: "The result of our program has been that by shifting men, mostly foremen, and in some cases even superintendents, mostly on a lateral basis, we have been able to match the creative requirements of the job with the creative potential of the man. The productivity of the low divisions has been raised and the productivity of the high divisions has been maintained."[15] (underscoring supplied)

Much of the credit for the boom in idea output is the result of the favorable atmosphere generated by the project. Dr. Richard Harris, General Supervisor of Education and Employment stated: "The atmosphere is the key to the whole thing. I'm sure we get a lot of ideas simply because the creativity project is going . . . ." (underscoring supplied)[16]

[14]A. L. Simberg and T. E. Shannon, "The Effect of AC Creativity Training on the AC Suggestion Program," AC Personnel Research Report No. 27 (Flint, Mich., AC Spark Plug Division, March, 1959). (Mimeographed)

[15]A. L. Simberg, "AC Spark Plug Creativity Program," from a speech at the Second Military Creative Problem Solving Seminar, April, 1962, at U. S. Army Management School, Ft. Belvoir, Va.

[16]"Planned Creativity Pays Off," Loc. cit.

In 1959, the Westinghouse Electric Corporation was faced with a problem familiar in industry. The manufacturing goals laid out for the ensuing five years were highly ambitious and modifications to existing processes had been refined to the point that the only way of reaching the objectives was by some creative breakthrough

Accordingly, after a careful eight month's study of creativity programs, both educational and industrial, Mr. H. C. Reel, General Supervisor of Manufacturing Training, instigated a creative training program. The Westinghouse program was built around a unique definition of creativity, namely: "the ability to trascend conventional patterns of thought." Based upon this definition, Westinghouse built a system to tear down blocks to creativity. Twenty-five percent of their course is devoted to theory and principles; the remainder is taken up with actual problems and techniques

Four operational techniques are taught in the Westinghouse course: design analysis and synthesis, involving the setting down of every characteristic of a process or product and looking for improvement; morphological analysis, in which all variables of a process or product are set down in a matrix arrangement and analyzed, brainstorming; and Synectics, which breaks down the entire creative process into six phases and provides mechanisms for inducing each of these phases.

Although their experience is relatively limited, Westinghouse credits the program with saving $300,000 in 1961 and $2,000,000 in 1962. Although it must be recognized that these figures were developed

by the section responsible for conducting the training, the program is obviously successful enough to convince top management to send over 2,500 employees to the course during the period 1960-63.

According to H. C. Reel, one of the major accomplishments of the course has been ". . . making foremen enthusiastic and cooperative about changes." (underscoring supplied)[17]

The Gary Works of U. S. Steel Creativity Program is an outgrowth of their management development program. The program, which began in 1956, has several distinguishing features worthy of mention. First, the company considers the activity so important that rather than attend classes part time, an entire week is set aside for the course. The trainees, who are supervisory personnel, come from various sections of the plant on a much sought-after quota basis. The group, about 30, is taken to the company's youth camp near the factory where they receive training very similar to that given at other companies. After learning the basic techniques, their time is utilized in small problem-solving seminars working on company oriented problems.

Perhaps the most unusual feature of the Gary program is their follow-up effort. The company has established a series of "task-forces" in the organization to work creatively on company problems and to encourage others to work creatively. Thus they hope to create an

[17]H. C. Reel, "Creativity in Management: Can it be Taught?" The Iron Age, Vol. 191, No. 1, (January 3, 1963), pp. 146-148.

atmosphere which is conducive to creative activity.[18]

Many additional case histories of industrial efforts to apply the expanding field of creativity could be provided. The examples cited, however, should suffice to provide tangible manifestation of top-level industrial managerial interest in creativity.

EDUCATIONAL PROGRAMS

The creative education movement has acquired increased momentum since recent research has found that creative potential can be measurably developed through education and training.[19]

The trend toward more creative education has been stimulated by two major conferences. The oldest is the Annual Creative Problem-Solving Institute held at the State University of New York at Buffalo. The tenth annual conference, scheduled for June of this year, includes a three-day concentrated course for new members followed by a two day course in practice teaching for advanced members. This year about 500 participants are expected. The instructional personnel this year will

[18]C. K. Turman, "Creative Problem-Solving in a Large Industrial Organization," from a speech at the first Military Creative Problem Solving Seminar, March, 1961, at U. S. Army Management School, Ft. Belvoir, Va.

[19]Sidney J. Parnes, "Can Creativity Be Increased," Personnel Administration, Vol. 25, No. 6 (November-December 1962), pp. 2-9.; J. P. Guilford, "Creativity: Its Measurement and Development," Parnes and Harding, op. cit., pp. 151-168.; Irving Maltzman, et. al., "Effects of Different Amounts of Training on Originality," Technical Report No. 3, and "The Persistence of Originality Training Effects," Technical Report No. 4 (unpublished reports prepared under Office of Naval Research Contract Nonr 233(50) at the University of California, Los Angeles, August, 1959).

will include such national leaders in creativity as Dr. C. W. Taylor, University of Utah, Dr. E. Paul Torrance, University of Minnesota, Dr. J. P. Guilford, University of Southern California; and Dr. Donald MacKinnon, University of California. This institute is co-sponsored by The Creative Education Foundation.

A second major conference, sponsored by the National Science Foundation, is held annually at the University of Utah. This conference, which serves as a clearing house for creativity research, dealt almost exclusively with identification of creative talent during the years 1955-1962. The scope of the conference has since been expanded to include developability of creative potential.[20]

Separate courses in creativity started in 1949 at the State University of New York at Buffalo. Since that time courses have been instituted gradually at other colleges and universities. Although there is no exact indication how many courses are being taught, the Creative Education Foundation supplied 1,700 instructors manuals to potential teachers during 1963.[21] In addition to the establishment of separate courses in Creative Problem-Solving, many courses have been restructured to be creatively oriented. These are the regular subjects into which creative principles and procedures have been incorporated. The current list of 94 subjects is over twice as long as reported only a year ago.[22]

[20]Alex F. Osborn, "The Creative Education Movement (as of 1964)," (Buffalo: The Creative Education Foundation, 1964), p. 5.

[21]Ibid., p. 10.

[22]Ibid., pp. 14-16.

One of the most effective methods of training an individual to utilize more fully his creative potential is used in the Management Curriculum at the U. S. Naval Postgraduate School, as well as in most other courses in management. Here reference is made to the Harvard Case method.

Under the case system, the student is assigned cases covering the different areas of management. He studies these cases, which are usually impartial situation reports with many possible problem-definitions, and comes up with a definite plan of action based on his view of the problem at hand. This gives him the experience of tackling a problem as broad, or as narrow, as he wishes. Because of the press of time, he is usually able to focus on only a few of the possible problem definitions.

Training in openness to experience and in reconsidering problem definitions comes when the student discusses these cases in class. In such discussion, one experience is dominant; the student realizes the narrowness of his own consideration of the problem. The student is under pressure, after hearing many definitions of the same problem, to redefine the problem himself. Thus, the case method teaches the value of redefining the problem under the pressure of new emphasis or information.

In addition to extensive utilization of the case method, The Harvard University Graduate School of Business also offers a course in "Creative Marketing Strategy." The catalogue description of this

course is quoted in pertinent part:

"This is a course concerned with the role of marketing in the growth and development of the individual business enterprise. Project work by small groups will constitute a major part of the course, with each group assuming a high degree of administrative responsibility. The word creative is used in the course title because the emphasis in the course is upon innovation. Although the course centers upon marketing, the solution of marketing problems will often require the consideration of other aspects of business, for example, product research and development, financial, manufacturing, and procurement problems. The orientation of the course is toward strategic rather than tactical problems. Strategic is used here to mean problems whose solution will extend over long periods of time and involve major commitments of company resources. The approach of the course, therefore, is at times from the position of the vice president in charge of marketing and at other times from the position of the chief executive of governing boards of the company. Students will be expected to chart future courses of action and develop programs for these companies. Class meetings will take a variety of forms including small group meetings."

In line with the catalogue statement, the course attempts to develop architects and designers, rather than critics. The course consists of a truly current problem of a business firm. In a typical term, five actual companies are used as projects, with two competing teams assigned to each. At the end of the course, teams present their findings and recommendations to the executives of the companies involved.

It is the opinion of the course instructors that this course supports the raison d'etre of the Business School - namely to train creative administors who can bring skills of imagination and intellect to problem-solving rather than rely on patterned problem-solving.

[23]Harry L. Hansen, "The Course in Creative Marketing at Harvard Business School," paper presented to the Fourth Annual Creative Problem-Solving Institute, June 23, 1958.

The late well-known Professor John E. Arnold was a pioneer in the teaching of creativity. He has taught courses in Creative Engineering at the Senior and Graduate level at the Massachusetts Institute of Technology and introduced a freshman course in Creative Thinking. He also acted as a consultant in creativity programs to A. C. Spark Plug, General Electric, Ford, and Corning Glass. His last teaching was done at Stanford University where he taught Creative Engineering. The main focus of Arnold's course was on searching for problems, or development of the questioning attitude. Without such an attitude the techniques previously discussed simply will not work.

The Creative Problem-Solving course at the University of New York at Buffalo utilizes Alex Osborn's book, Applied Imagination, as a text. The text emphasizes the importance of imagination in all walks of life, the universality of creative talent, and the use of creativity in all stages of problem-solving. All of the techniques for stimulating ideation (except Synectics) described hereinbefore are taught in the course. Primary emphasis is on teaching the student to tackle a problem creatively. It is also designed to provide the student with a greater appreciation of his creative potential and with a more creative attitude.[24]

Research indicates that one semester courses in creative problem-solving can measurably develop student abilities to think up good ideas. One study at New York University at Buffalo showed that undergraduates

[24]Sidney J. Parnes, "The Creative Problem-Solving Course at the University of Buffalo," Parnes and Harding, op. cit., pp. 307-311.

who had taken the course averaged a 94% improvement in idea-producing skill.

"Although courses in creative problem-solving teach usable methodologies, they primarily serve to bring about improvements:

"1. In understanding: keener consciousness of the fact that all of us are gifted with creative potential . . . Realization of the fact that we can deliberately extend the use of our innate talent . . . Recognition of the fact that we can deliberately do much to develop our own creative potential.

"2. Behavioral Habits: The habit of attacking problems creatively . . The habit of applying needed effort . . . The habit of encouraging creativity in others."[25]

CREATIVITY PROGRAMS IN THE ARMED FORCES

Now that we have looked briefly at creativity programs of industry and education, let us turn to the armed forces. Our nation is committed to spending approximately $50 billion per year for national defense In an organization which spends such vast sums, one would surely expect to find every effort devoted to the development of creative problem-solving in order to provide maximum defense for the funds expended. Unfortunately such is not the case. There are very limited examples of either conscious efforts to utilize or improve creativity in the armed forces.

[25]Osborn, op. cit., pp. 12-13.

So far as can be determined the Navy does not have any formal programs utilizing creative problem-solving. This is particularly surprising because the Navy has long been a leading supporter of research into the identification of creative talent. The Office of Naval Research has, since the early 1940's, supported the investigations of Dr. J. P. Guilford at the University of Southern California, Dr. D. W. Taylor at Yale, and until recently Dr. D. I. Maltzman at the University of California.[26] Despite the Navy's financial support of this program, no formal effort has been made to utilize the results.

The U. S. Navy Bureau of Ships did have, under the title Value Engineering, a creativity program for several years. This program, started in 1958, received extensive Navy-wide publicity in the Bureau of Ships Journal: during 1960 there were twenty articles on the subject; during 1961, eight; during 1962, eight; since none. In view of the reported gains from the program, i.e., $6.7Million reduction in costs in 1961 alone, this apparent decrease in emphasis is not understandable.[27]

A distinguishing feature of the Value Engineering Program was the effort to obtain fleet-wide participation. The March 1960 Bureau of Ships Journal had bound in it a postcard to be used for the submission of suggestions concerning Value Engineering projects.[28] The response to this

[26]John A. Nagay, Personnel and Training Branch, Office of Naval Research, personal letter to CDR W.D. Wessinger, ONR:458:Jan, December 18, 1963.

[27]"VE -- Trends and Methods in Naval Shipyards," Bureau of Ships Journal, Vol. 11, No. 1 (January 1962), p. 12.

[28]"Post Cards for Submitting Suggestions," Bureau of Ships Journal Vol. 9, No. 3 (March 1960), p. 8.

effort is not known at this time. (Perhaps the response was so overwhelming that the time required to review the suggestions caused the apparent demise of the program.)

In contrast to the Navy, both the Air Force and the Army have made concerted efforts to improve military problem-solving capability of their personnel through education and training in creative thinking. The program of each service will be discussed separately

The Air Force has a broad although non-comprehensive program in Creativity. All participants in the Air Force Reserve Officer Training Corps (AFROTC) are required to take a course in Creative Problem Solving. The course is given in 10 separate lessons, requiring 19 classroom hours.

The objectives of the course are to:

1. Convince the student that (a) he has a greater capacity for creative thinking than he is aware of; and (b) success in any profession is geared to the ability to solve problems creatively.

2. Afford the student (a) a knowledge of the principles and procedures of creative problem-solving, and (b) individual and group experiences that develop skill in the ability to solve problems creatively.[29]

Applied Imagination is the primary text for the course and, as with most other creativity courses, the emphasis is on small informal participative groups. It is primarily a "doing" course. More than 50,000 Air Force Cadets have completed this course on some 200 campuses.

[29] Instructor's Guide for Creative Problem Solving, Headquarters AFROTC, Air University, Maxwell Air Force Base, Alabama, April, 1956.

The Air University officer professional military education schools and colleges have emphasized the techniques of creative thinking.

Although the Squadron Officer School devotes only one hour of lecture and one hour of seminar to creative thinking, the school uses two other devices to stimulate creativity on the part of students. The first is the preparation of a paper on Aerospace Power for which the students are given these instructions:

1. Top Air Force commanders are interested in new ideas about the use of aerospace power in this modern age. The leaders of today look to the leaders of tomorrow to develop thinking about aerospace power. As a student in the Squadron Officer School, you are a potential leader in the Air Force and you must learn to do independent thinking about aerospace power. Therefore, you are asked to make a study about some facet of basic doctrine or a current Air Force problem and write a paper giving the results of your thinking on the subject.

2. The Aerospace Power study is the most important written exercise in the Squadron Officer School writing program. The purpose of the study is to have you express your own ideas about aerospace power. Do not quote excessively or paraphrase what someone else has written. This school is interested in your ideas.[30]

Probably the most effective portion of the creative training given at the Squadron Officer School is a ten hour seminar entitled "Conceptual Thinking About the Air Force of the Future". One of the objectives of the seminar is to increase interest in conceptual thinking about the Air Force of the future. It is interesting to note that this course is given after all formal evaluation of students has been completed in order to encourage "free-wheeling" creative discussion.

[30]Letter addressed to students Squadron Officer School, subject: Aerospace Power Study, (Maxwell Air Force Base, Alabama, not dated).

The Air Command and Staff College curriculum includes two hours (one lecture, one seminar) of formal presentation about creative thinking. The Air War College schedules only one hour on the subject. The objectives of the lecture, which seem overly ambitious for the time scheduled, are to explain:

a. The thought process in problem solving
b. The psychological aspects of creative thinking
c. The effects of emotion and attitude on the problem solving process
d. The relation of creativity to the problem solving process
e. The application of reasoning to problem solving.

This brief description of the Air War College is not intended to imply that creativity is not stressed since much depends on the educational environment.

It has been informally ascertained that the Air Force is planning to expand their creative education program to include some formal training at the two Non-Commissioned Officer Academies.

Under the initial guidance of Colonel W. W. Culp, former Commandant of the U. S. Army Management School and now President of the Ohio School of Engineering, the Army has taken the lead in attempting to improve creativity at the management level. The Army's program started in 1961 with a Military Creative Problem-Solving Seminar conducted by the Creative Education Foundation. All services sent senior representatives to this seminar and their reaction can be summed up in the comments of a Rear Admiral who wrote. ". . . this letter is to place on record my enthusiastic support of the creative approach to the solution of military problems -- I believe that the principles demonstrated at the seminar

have a wide application at the staff and command levels."[31]

The Army's Management School has expanded the program rapidly during the intervening period and now, in addition to the annual seminar, conducts a course in Military Creative Problem-Solving as an integral part of the overall management program. The present course consists of ten hours of lecture and seminar as part of a ten week course.

The same course is also taught, as a common subject under the auspices of the Management School, at seventeen other Army Service Schools, including the Logistics Management Center and the Provost Marshal General's School. Consideration is being given to extending the course into the non-commissioned officer schools.

In preparing the lesson plans for the course, the staff of the Management School adopted a four phased approach to military creative problem solving. These phases are:

I. Intelligence, stresses the importance of awareness and sensitivity to problems.

II. Creative attack, provides a variety of techniques which emphasize the accumulation of a large number of alternatives from which a unique solution can be selected.

III. Judgment, comprising two parts: synthesis to relate and combine alternatives and evaluation to rank them in terms of probable success.

[31] Army, Navy, Air Force Journal, Vol. 98, P. 1379. (22 July 1961) p. 11.

IV. Execution, which dwells on the actions necessary to achieve approval of the chosen course of action.

An integrated approach, utilizing seminars, cases, and exercises, is taken in the presentation of the course. The course opens with a guest lecturer speaking on "Why We Need Creativity in Management," followed by a faculty presentation on "Concepts of Applied Creativity."

After this introduction, several cases are considered to provide participants an opportunity to develop new solutions to "live" problems. (Problems which the students actually face) The atmosphere of the course promotes creative resolution of professional, experimental, and emotional differences.

Exercises have been incorporated into the course which demonstrate:

the psychology of free association,

the attitudes and mental skills essential to inductive reasoning,

the techniques of joint technical-administrative problem solving

and the skills essential to creative problem-solving in a "systems" environment.

Students who have completed the course have been unanimous in the opinion that they will derive great benefit from this course. It is probable that the payoff, particularly in the short term, will be greater from this course than from any similar course taught by the Armed Forces. One reason for the high payoff is that the student body is entirely middle and upper members of the management hierarchy. (Majors up)

It is of interest that the Army Management School has recently been made into a Joint School. It is therefore, probable that the Navy will soon gain some benefit from the Army's initiative in the field of Creative Military problem-solving.

CHAPTER IV

THE APPLICATION OF CREATIVITY TO PROBLEM-SOLVING AND DECISION MAKING

The story is told of the graduate of a well known business school who had been extensively trained in problem-solving, but who lasted only a few weeks in his first job. When he was questioned by one of his old professors, the graduate made it clear that he had not failed in problem-solving, because, he said, "They didn't have any problems, all they had was a mess!"

This frequently recounted bit of humor strikes to the heart of the dilemma in which the naval officer finds himself. How shall the "mess", the facts which mean nothing, or everything, in a going operation, be converted into recognizable problems which can be solved in accordance with some defined method?

Because of their preoccupation with the life and death aspects of problem-solving, as well as their traditional requirement for conformity, the military services have led the way in formalizing and standardizing classical problem-solving. The staff study and the estimate of the situation are today widely used as guides in the non-military departments of government and in business.[1] However, it is noteworthy in the case

[1] Kenneth W. Thompson, Christian Ethics and the Dilemmas of Foreign Policy (Durham, N. C.: Duke University Press 1959). p. 187-190.

of both that the problem is essentially a given. The thinking that conceived the problem is implicit and beyond question. Yet Einstein, one of the greatest problem solvers of modern times said,

"The formulation of the problem is often more essential than its solution . . . To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science."[2]

The U. S. Army Management School at Fort Belvoir, in cooperation with the Creative Education Foundation of Buffalo, New York, has developed concepts and techniques which: (1) disclose the subjective content of problem solving; (2) distinguish between the phases of problem-solving requiring different intellectual attitudes; and (3) establish criteria for use in problem formulation and evaluation which are consistent with the need for calculated risk-taking, rather than calculated risk-avoidance.[3] Reinforcing this effort is the current emphasis at the top levels of the Department of Defense upon the need for more alternatives.

The methods suggested by the Army for creative problem-solving and decision making are not magic formulas that will produce imaginative thinking. They do represent one approach which has been found to be effective. There are many other effective methods which can be used to stimulate the creative potential of individuals, and the citing here of this representative approach is not intended to imply that it is superior to others which have been devised

[3]"Lesson Plan for Army Management," MF-29-CS (Fort Belvoir, 1962), p. I5.

Creativity involves an approach to problems more basic than the accident of professional training. There are two general classes of problems. Those that have one right answer, and those that are multisolutional. It is the latter group that lend themselves to creative attack. There is a multiplicity of answers - a spectrum - a continuum with no ends. The best solution today can be replaced with a better one tomorrow.

In order to highlight the method employed in problem formulation, the phase of problem-solving that begins with a mess and ends with a defined problem is titled the "Intelligence" phase. Sequential phases are entitled "Creative Attack", "Judgment", and "Execution."

The intelligence phase presumes an awareness of a state of disequilibrium. From such awareness one is motivated to achieve a new order. Awareness implies sensitivity to problems, for creativity cannot occur unless one is aware that a problem exists. Some individuals possess a well developed sensitivity; others need training to help develop their latent problem sensitivity; some may never develop it.

In the creative attack phase, phase II, problems developed in the preceding phase are attacked using the techniques described in Chapter 2. Creative attack can be an individual effort, a group effort, or both.

Phase III, judgment, is accomplished in two separate steps; "synthesis" and "evaluation". Synthesis relates and combines ideas or alternatives derived from phase II while evaluation ranks ideas or

alternatives in terms of specific criteria to determine their probable success in solving the problem. The conclusion of this phase is a decision to implement one of the alternatives.

Phase IV, the execution phase, involves efforts to use the products of phase II, as evaluated by phase III. This requires that we gain acceptance of our selected problem solution. This frequently requires a high order of "creative selling" to overcome resistance to change and to gain organizational approval and implementation of the proposed alternative.

Since it is usually necessary to challenge the status quo to be creative, the culture must tolerate deviations from the traditional and permit the individual to seek new experiences and new directions. This requires reinforcement, by favorable environmental factors which provide a climate encouraging to creativity and which provides support for those engaging in the proces. These thoughts suggest new leadership, organizational, and interpersonal viewpoints.[4]

[4] Ibid. p. II-12.

CHAPTER V

THE NATURE OF THE NAVY'S NEED FOR CREATIVITY

The Navy has undertaken (and is undertaking) vast programs to increase its capabilities in all areas. Education is receiving great stress to provide increased knowledge as a base for new developments both in technical and managerial areas. Problems caused by the exponential growth rate of scientific research and development are enormous. The support of our increasingly complex weapons presents us with major problems. Management and planning force requirements and utilization pose additional problems whose magnitude is almost beyond the scope of our management capability.

The stated goals of the Soviet Union in carrying out the aims of international communism and their demonstrated capability to wage war represent basic challenges to which the Navy must address its efforts. The magnitude of the Soviet submarine threat alone demands the application of creativity to problem solving if this threat is to be countered.

It is pertinent to this study to examine briefly the Soviet view of creative thinking. The Soviets have been very successful in their rapid development of science and technology. Their problems in achieving this advanced technological state must have been similar, perhaps even greater, to those of the United States How does the Soviet Union view creative thinking?

In 1958, Premier Khrushchev remarked concerning the importance of individual development and creative endeavor:

"The socialist system offers unlimited opportunities for the all-round development of personality and for creative endeavor. Socialism opens up greater prospects for scientists, engineers, and technicians, for our intellectuals, for every Soviet man and woman, than the capitalist system ever could." (underscoring supplied)[1]

Soviet literature is replete with the use of the word "creative". The Party Program approved by the 22nd Party Congress in 1961 gave strong new emphasis to creativity. The following excerpts are significant:

"The working people's consciousness that they are working not for exploiters but for themselves, for their society, gives rise to labor enthusiasm, innovation, creative initiative, and mass socialist competition. Socialism is living creativity by the working masses." (underscoring supplied)[2]

Even this cursory review of the Communist Party Platform indicates the presence of deep emphasis on and appreciation of creativity.

David Granick in his book The Red Executive, presents information to indicate the Soviet manager is considerably ahead of the manager in the United States in the effective utilization of the creative ability of the workers.

In the area of military management, Soviet Major General Beorgy I. Pokrosky, head of the Soviet Army Engineering Technical Services, has written at length on the importance of creativity, with particular emphasis

[1]U. S. Department of State Publication 6836, Soviet World Outlook (Washington: U. S Government Printing Office, July, 1959), p. 163.

[2]Current Soviet Policies IV, The Documentary Record of the 22nd Congress of the Communist Party of the Soviet Union, edited by Charlotte Saikowski and Leo Gruliow from the Translations of the Current Digest of the Soviet Press (New York: Columbia University Press, 1962), p. 3.

on the importance of the social sciences. His book, Science and Technology in Contemporary War, was written primarily "to contribute to the development of creative thought."[3] He underscores the importance of creative thinking to the modern military man and holds that military technology in particular requires "conditions which are conducive to that which is most valuable in man -- the exercise of his creative and critical thought and imagination."[4]

The results of Soviet progress are well known. This progress stems in large part from their all-out successful efforts to develop creativity.

The results of Soviet progress are well known. This progress stems in large part from their all-out successful efforts to develop creativity.

The navy has a dominant role in providing for the security of the nation. As the sea arm of the United States, and a predominant instrument of national policy, the Navy's goals are those of the Nation. The paramount aspirations of the United States were set long ago. They were reiterated by the President's Commission on National Goals in 1960. The dominant goal is to guard the rights of the individual, to ensure his development, and enlarge his opportunities.[5]

[3]G. I. Pokrovsky, Science and Technology in Contemporary War (New York: Fredrick A. Praeger, 1959), p. 14.

[4]Ibid., p. 88.

[5]Goals for Americans, The Report of the President's Commission on National Goals, Administered by the American Assembly, Columbia University (Englewood Cliffs: Prentice-Hall, Inc., 1960), p. 1.

National survival is the basic raison d'etre of the military services. The national goal which the Navy seeks to achieve by protection of the Nation is the dignity and development of the individual. This goal is common to the Nation, the Navy, and the individual. Thus, the psychologically desirable integration of goals exists in the National-Navy-individual relationship.

Another interesting relationship can be viewed at this point. Motivating the individual's goal-striving for personal development is the inherent need for creative expression. Creative expression is also a great need of the Nation and the Navy in solving the myriad problems connected with the protection of the individual's opportunities to develop.

The observation that these relationships exist is simple and reasonable. There have been suggestions of a slowing down of the national creative desire which should focus even greater intensity on the national need for stimulating and exploiting creative potential. The Rockefeller Report, The Pursuit of Excellence, which discusses at length the national needs for excellence, summarizes the importance of utilizing the individual's potential.

The grave responsibilities of the Navy demand that Navy management be creative. The United States is engaged in a technological war. It is clear that the balance of forces in the Cold War between East and West hinges largely on technological change. The greatest threat is the possibility that the Soviets might achieve a significant technological breakthrough. We are constantly striving to counter this threat by seeking

technological breakthrough ourselves. It is Navy management which must develop the optimum environment for efficiency of creative thinking in order to enhance the probability of our achieving any breakthrough first. The environment must be conducive to the cultivation of innovative thinkers of the caliber of Maury, Dahlgren, and Rickover. Such non-conformists were never more sorely needed; the requirement for new ideas brought to fruition was never more urgent.

The one element common to all problems is the individual. It is the capability of the individual to solve all problems that represents the greatest single need of Navy management. The individual is the most vital resource. The supreme value of the individual is his ability to think creatively in solving problems.

Briefly reviewing the Navy's needs for creative thinking, it is seen as (1) urgent in view of the Soviet threat; (2) closely identified with the goals of the nation and the individual; and (3) vital to the needs of Navy management in all areas.

To this point, this paper has attempted to explore the nature of creative thinking to determine its basic characteristics and some proven techniques for stimulating the potential in all individuals. It has also explored the nature of the Navy's needs for creative thinking to determine in what ways creative thinking is important to the Navy.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

It has not been the purpose of this paper to prepare the way for a series of DO's and DON'T's which an innovation orientated organization might adopt. On the contrary, the intention has been to reach a series of broad conclusions with respect to the nature of creativity and the ways and means available for stimulating and utilizing creativity to produce new ideas of value to the organization.

CONCLUSION

The most obvious conclusion that we can draw is that a much better understanding is needed of what creativity is and how it operates.

RECOMMENDATION

Research into mental processes of creativity has shown promise and should be intensified. There is a clear need for more preliminary attention to the criteria of creativity: the identification and definition of what is and what is not creative behavior. With research more firmly based on reliable and valid criteria, studies of the relevant psychological elements of creativity should be considerably more revealing and useful than such studies so far. Environmental variables can be systematically investigated. Highly creative groups or organizations can be compared with less creative groups. Controlled laboratory experimental studies can be made. Recommendations can be made on the basis of proven rather than inferred relationships. Because of the promising start that

has been made and the importance of the subject, research into the definition and identification of creativity processes should receive increased support and encouragement from the Navy.

CONCLUSION

Industry, faced with a continuing and increasing need for technological advance, has developed some sound, practical programs. Although it is extremely difficult to quantify the end results of industry training programs, there seems to be no question, at least in the minds of the business leaders, regarding the value of the programs. Increasingly larger numbers of industrial organizations are establishing their own training programs.

RECOMMENDATION

It is recommended that the Navy carefully examine industrial programs in creativity and incorporate appropriate procedures into a Navy training program.

CONCLUSION

There is no longer any doubt that the inherent creative potential of individuals can be improved with training.

RECOMMENDATION

It is recommended that creative thinking courses be incorporated into the curricula of Navy Schools, particularly the Naval Academy, The Naval Officer Training Corps (NROTC), the Naval Postgraduate School, and the Naval War College.

If courses were included in each of these schools, officers would have an opportunity for periodic refresher training on the techniques of creativity.

CONCLUSION

The existing tests for creativity cannot provide an exact index of ability. However, the existing tests are good enough to provide indication of the relative creative ability of individuals.

RECOMMENDATION

Investigate the possibility of testing creative potential and incorporate this as a factor in billet descriptions and personnel assignment. Assign to those billets requiring creativity those individuals shown by tests to be most likely to possess such ability.

CONCLUSION

If creative activity is desired in the Navy, a creative environment must be established. The necessity of a creative environment is common to the Navy and industry.

RECOMMENDATION

Investigate more fully the steps being taken in industry to create an atmosphere conducive to creativity and incorporate appropriate portions of industry's efforts into Navy procedures.

CONCLUSION

The Navy officer fitness report system emphasizes behavior that encourages careful, judicial, and generally conforming actions. It is obviously vital that such factors be evaluated. However, stressing such factors to the total exclusion of evaluation of novel, imaginative, and creative behavior unjustly penalizes the creative innovator.

RECOMMENDATION

It is a well known and generally accepted fact that desired activity can be increased by reinforcement in the form of a reward.

It is, therefore, recommended that the fitness report form be revised to include the factor of creativity.

The Navy fitness report form immediately preceding the 1962 revision (the one now in use) contained the following section:

"20. State your estimate of this officer's capacity for original and constructive professional work and indicate to what degree his performance during this reporting period has reflected that capacity. State concrete attainments wherever possible If not observed, so state."

The addition of a similar section to the current report, together with increased emphasis on this section in the instructions for preparing reports should go far toward accomplishing this recommendation.

CONCLUSION

In order to effectively carry out our mission in the national defense effort, we need more creative guidance in the top and upper middle management levels of the Navy.

RECOMMENDATION

It is recommended that proven creative ability be included as a factor leading to promotion, particularly early promotion. This could be done most easily by including in the instructions to selection boards guidance on the Navy's needs in this area.

"It is the old that prevents us from recognizing the new." Comte

BIBLIOGRAPHY

BOOKS

Barron, Frank. Creativity and Psychological Health. New York: D. Van Nostrand Company, Inc., 1963.

*Bellows, Roger, Thomas Q. Gilson, and George S. Odiorne. Executive Skills. Englewood Cliffs: Prentice-Hall, Inc., 1962.

Benton, Mildred. Creativity in Research and Invention in the Physical Sciences. Washington: U. S. Naval Research Laboratory, 1961. (An Annotated Bibliography).

*Blood, Jerome W., (editor). The Management of Scientific Talent. AMA Management Report No. 76. New York: American Management Association, 1963.

Boutoutline, Serge Jr., et al. Individual Creativity and The Corporation. Boston: The Institute of Contemporary Art, 1959.

Braunm, John R., (editor). Contemporary Research in Learning. New York: D. Van Nostrand Company, Inc., 1963.

Brodie, Bernard. Strategy in the Missile Age Princeton: Princeton University Press, 1959.

Bross, Irwin D. J. Design for Decision. New York: The MacMillan Company, 1957.

*Clark, Charles H. Brainstorming. Garden City, New York: Doubleday and Company, Inc., 1958.

*Coleman, James C. Personality Dynamics and Effective Behavior. Chicago: Scott, Foresman and Company, 1960.

*Costello, Timothy W., Sheldon S. Zalkind. Psychology in Administration. Englewood Cliffs: Prentice-Hall, Inc., 1963.

Dimock, Marshall E. Administrative Vitality. New York: Harper and Brothers, 1959.

*Gordan, William J. J. Synectics. New York: Harper and Row, 1961.

*Gruber, H. E., Glenn Terrell, and Michael Wertheimer. Contemporary Approaches to Creative Thinking. New York: Atherton Press, 1963.

*Indicates primary source

*Hinrichs, John R. Creativity in Industrial Scientific Research: A Critical Survey of Current Opinion, Theory, and Knowledge. AMA Management Bulletin No. 12. New York: American Management Association, 1961.

*Jones, Manley H. Executive Decision Making. Homewood, Illinois: Richard D. Irwin, Inc., 1957.

Kogan, Zuce. Essentials in Problem Solving. New York: Arco Publishing Co., 1956.

Lehrer, Robert N. Work Simplification: Creative Thinking About Work Problems. Englewood Cliffs: Prentice-Hall, Inc., 1957.

*Mason, Joseph G. How to be a More Creative Executive. New York; McGraw-Hill Book Company, Inc., 1960.

McClelland, David C. The Achieving Society. Princeton: D. Van Nostrand Company, Inc., 1961.

Nichols, Ralph G. and Leonard A. Stevens. Are You Listening? New York: McGraw-Hill Book Company, Inc., 1957.

*Osborn, Alex F. Applied Imagination. New York: Charles Scribner's Sons, 1953.

*Osborn, Alex F. Your Creative Power. New York: Charles Scribner's Sons, 1948. Revised and reprinted Dell Publishing Company, 1961.

*Parnes, Sidney J., and Harold F. Harding, (editors). A Source Book for Creative Thinking. New York: Charles Scribner's Sons, 1962.

*Poyla, G. How To Solve It. Princeton: Princeton University Press, 1945.

*Richards, Max D., and William A. Nielander (editors). Readings in Management. Chicago: South-Western Publishing Co., 1958.

*Stein, Morris I., and Shirley J. Heinze. Creativity and the Individual. Glencoe, Ill.: The Free Press of Glencoe, 1960. (A McKinsey Foundation Annotated Bibliography.)

Taylor, Calvin W. (editor). The 1955 University of Utah Research Conference on the Identification of Creative Scientific Talent. Salt Lake City: University of Utah Press, 1956.

Taylor, Calvin W., and Frank Barron, (editors). Scientific Creativity: Its Recognition and Development. New York: John Wiley and Sons, Inc , 1963.

Uhr, Leonard, and James G. Miller (editors). Drugs and Behavior. New York: John Wiley and Sons, 1960.

*Von Fange, Eugene K. Professional Creativity. Englewood Cliffs: Prentice-Hall, Inc., 1959.

ARTICLES AND PERIODICALS

Bienvenu, Bernard J. "What Kind of Training for Tomorrow?" Personnel, Vol. 38, No 6., pp. 8-17.

Blansfield, Michael G. "Managers in Wonderland," Management Review, Vol. 49, No. 10, October, 1960, pp. 9-13, 75-79.

Brown, Alfred E. "Creativity Can be Sparked in Many Different Ways," Chemical and Engineering News, Vol 38, No. 43, October 24, 1960, pp. 102-110.

"Can Decision-Making be learned?" Navy Management Review, NAVEXOS P-910, Vol. 5, No. 8, August, 1960, p. 3.

*Cassels, Louis. "Eight Steps to Better Training," Nation's Business, Vol. 49, No. 3, March, 1961, pp. 40-51, 90-93.

Clark, Blake. "You Can Learn to Think Creatively," The Reader's Digest, reprint from October, 1960.

Colclough, O. S. "Creativity for Executives," The Journal of the Armed Forces Management Association, Vol. II, No. 3, March, 1964, pp. 13-15.

*Corson, John J. "Innovation Challenges Conformity," Harvard Business Review, Vol. 40, No. 3, May-June, 1962.

Douglas, James H. "It Takes Digging to Discover . . ." Armed Forces Management, Vol. 7, No. 1, October, 1960, p. 32.

*Durfee, R. A. and A. L. Brophy. "How to Stifle Creativity," Personnel, Vol. 38, No. 4, July-August, 1961, pp. 63-66.

Editorial, "Imaginative Thinking for Management," Dun's Review, Vol. 77, No. 5, May, 1961, p. 35.

"Employee-Inventor Gets His Cut," Business Week, No. 1751, March 23, 1963, pp. 133-134.

Gaddis, Paul O. "The Age of Massive Engineering," Harvard Business Review, Vol. 39, No. 1, January-February, 1961, pp. 138-145.

*Glass, Stephen J. "Creative Thinking Can be Released and Applied," Personnel Journal, Vol. 39, No. 5, pp. 176-177.

*Jarman, Rufus. "How to Encourage Ideas," Nation's Business, Vol. 4, No. 3, March, 1957, pp. 32-33.

Kerr, Clark, et al. "Industrialism and World Society," Harvard Business Review, Vol. 39, No. 1, January-February, 1961, pp. 113-136.

Leavitt, Harold J. "Unhuman Organizations," Harvard Business Review, Vol. 40, No. 4, July-August 1962, pp. 90-98.

*Leavitt, Harold J. and Thomas L. Whisler. "Management in the 1980's," Harvard Business Review, Vol. 36, No. 6, November-December, 1958, pp. 41-48.

Levine, Abraham S. "Group Creativity," Naval Research Reviews, NAVEXOS P-510, January, 1964, pp. 7-9.

Levitt, Theodore. "Management Versus the Failure of Commercial Research," Advanced Management, Vol. 24, No. 10, October, 1959, pp. 12-16.

*Levitt, Theodore. "Creativity is Not Enough," Harvard Business Review, Vol. 41, No. 3, May-June, 1963, pp. 73-83.

*Parnes, Sidney J. "Can Creativity be Increased?", Personnel Administration, Vol. 25, No. 6, November-December, 1962, pp. 2-9.

*Parnes, Sidney J. "Education and Creativity," Teachers College Record, Vol. 64 No. 4, January, 1963.

*"Planned Creativity Pays Off," Nation's Business, Vol. 45, No. 1, January, 1957, pp. 34-35, 48-50.

*Raudsepp, Eugene. "How to Boost Idea Power," Nation's Business, Vol. 49, No. 1, January, 1961, pp. 74-80.

*Reel, H. C. "Creativity in Management: Can it be Taught?" The Iron Age, Vol. 191, No. 1, January 3, 1963, pp. 146-148.

Scientific American, Vol. 199, No. 3 (September, 1958) Issue entitled "Innovation in Science."

*Stanton, Erwin S. "Fostering Creativity and Innovation in Management," Personnel, Vol. 40, No. 6, November-December 1963, pp. 45-52.

Summer, Charles E. Jr. "The Managerial Mind," Harvard Business Review, Vol. 37, No. 1, January-February, 1959, pp. 69-78.

*"The Management of Innovation," Management Review, Vol. 51, No. 9, September, 1962, pp. 50-52.

Value Engineering Staff. "You Can Earn Extra $$$$$," Bureau of Ships Journal, Vol. 9, No. 2, February, 1960, pp. 16-18.

_____. "Post Cards for Submitting Suggestions," Bureau of Ships Journal, Vol. 9, No. 3, March, 1960, p. 8.

_____. "Creative Thinking . . . A Value Engineering Technique," Bureau of Ships Journal, Vol. 9, No. 9, pp. 10-13.

_____. "The Value Engineering Job Plan," Bureau of Ships Journal, Vol. 9, No. 11, pp. 14-15.

_____. "Speculative Phase - Second Step in Value - Engineering Job Plan," Bureau of Ships Journal, Vol. 10, No. 3, March, 1961, pp. 26-27.

_____. "Value Engineering -- Needlers for Cost-Reduction Ideas," Bureau of Ships Journal, Vol. 10, No. 4, April, 1961, pp. 18-19.

_____. "Who is Responsible for Value?" Bureau of Ships Journal, Vol. 10, No. 6, June, 1961, pp. 16-17.

_____. "VE -- Trends and Methods in Naval Shipyards," Bureau of Ships Journal, Vol. 11, No. 1, January, 1962, pp. 11-13.

_____. "Duty on VE Pays Off," Bureau of Ships Journal, Vol. 11, No. 4, April, 1962, pp. 23-24.

REPORTS AND COLLECTIONS

*Creative Engineering Seminar, 1956. Compiled by John E. Arnold. Cambridge, Mass: Massachusetts Institute of Technology, 1956.

*Creative Engineering Seminar, 1959. Compiled by John E. Arnold. Stanford: Stanford University, 1959.

*Creativity: Key to Continuing Progress. American Management Association Management Bulletin No. 4. New York: American Management Association, 1960.

Rockefeller Brothers Fund. The Pursuit of Excellence: Education and the Future of America. Panel Report V of the Special Studies Project. Garden City, New York: Doubleday and Company, Inc., 1958.

*"Lesson Plan for Army Management," MF-29-CS. Fort Belvoir Va.: U. S. Army Printing Service, 1962.

UNPUBLISHED MATERIALS

Allen, Myron S. "The Evaluation of Selected Intellectual Factors by Creative Research Scientists." University of Southern California Psychology Laboratory Studies of Aptitudes of High Level Personnel Number 25, April, 1960.

Guilford, J. P., N. W. Kettner, and P. R. Christenson. "A Factor-Analytical Study Across the Domains of Reasoning, Creativity, and Evaluation."
I. "Hypotheses and Description of Tests." July, 1954.
II. "Administration of Tests and Analysis of Results." March, 1956. University of Southern California Psychology Laboratory Studies of Aptitudes of High Level Personnel, Numbers 11 and 16.

Maltzman, Irving, et. al. "Effects of Different Amounts of Training on Originality." Technical Report No. 3. Los Angeles: University of California, 1959.

_____. "On the Training of Originality." Technical Report No. 5. Los Angeles: University of California, 1959.

McQueen, Lawrence P. "Creative Problem Solving - A Challenge to Management Theory and Practice." Washington, D.C., Industrial College of the Armed Forces, 1963. Thesis.

Merrifield, P. R., and J. P. Guilford. "A Factor-Analytical Study of Problem-Solving Abilities." University of Southern California Psychology Laboratory Studies of Aptitudes of High Level Personnel Number 22, March, 1960.

*Taylor, Donald W., et. al. "Does Group Participation When Using Brainstorming Facilitate or Inhibit Creative Thinking." Technical Report No. 1. New Haven, Conn.: Yale University, 1957.

_____. "Should Group or Individual Work Come First on Problems Requiring Creative Thinking When Equal Time is Devoted to Each?" Technical Report No. 2. New Haven: Yale University, 1957.

_____ (editor). "Experiments on Decision Making and Other Studies." Technical Report No. 6. New Haven: Yale University, 1960.

_____. "Thinking." Technical Report No. 7. New Haven: Yale University, 1962.

*_____. "Decision Making and Problem Solving." Technical Report No. 9. New Haven: Yale University, 1963.

APPENDIX A

HOW TO SOLVE IT

First — You have to understand the problem.

UNDERSTANDING THE PROBLEM

What is the unknown? What are the data? What is the condition? Is it possible to satisfy the condition? Is the condition sufficient to determine the unknown? Or is it insufficient? Or redundant? Or contradictory? Draw a figure. Introduce suitable notation. Separate the various parts of the condition. Can you write them down?

Second — Find the connection between the data and the unknown.

You may be obliged to consider auxiliary problems if an immediate connection cannot be found. You should obtain eventually a plan of the solution.

DEVISING A PLAN

Have you seen it before? Or have you seen the same problem in a slightly different form? Do you know a related problem? Do you know a theorem that could be useful? Look at the unknown! Try to think of a familiar problem having the same or a similar unknown.

Here is a problem related to yours and solved before. Could you use it? Could you use its results? Could you use its method? Should you introduce some auxiliary element in order to make it useful? Could you restate the problem? Could you restate it still differently? Go back to definitions.

If you cannot solve the proposed problem, try to solve first, some related p oblem. Could you imagine a more accessible related problem? A more general problem? A more specific problem? An analogous problem? Could you solve a part of the problem? Keep only a part of the condition, drop the other part; how far is the unknown then determined? How can it vary? Could you derive something useful from the data? Could you think of other data appropriate to determine the unknown? Could you change the unknown or the data or both if necessary, so

that the new unknown and the new data are nearer to each other? Did you use all the data? Did you use the whole condition? Have you taken into account all essential notions involved in the problem?

Third CARRYING OUT THE PLAN

Carrying out your plan of the solution, check each step. Can you see clearly that the step is correct? Can you prove that it is correct?

Fourth EXAMINE THE SOLUTION OBTAINED

Can you check the result? Can you check the argument? Can you derive the result differently? Can you see it at a glance? Can you use the result or the method for some other problem?

G. Polya, How to Solve It (Princeton: Princeton University Press, 1945), inside front cover.

APPENDIX B

CHECK LIST FOR NEW IDEAS

Put to other uses? New ways to use as is? Other uses if modified?

Adapt?

What else is like this? What other ideas does this suggest? Does past offer a parallel? What could I copy? Whom should I emulate?

Modify?

What to add? More time? Greater frequency? Stronger? Higher? Longer? Thicker? Extra value? Plus ingredient? Duplicate? Multiply? Exaggerate?

Minify?

What to subtract? Smaller? Condensed? Miniature? Lower? Shorter? Lighter? Omit? Streamline? Split up? Understate?

Substitute?

Who else instead? What else instead? Other ingredient? Other material? Other process? Other power? Other place? Other approach? Other tone of voice?

Rearrange?

Interchange components? Other pattern? Other layout? Other sequence? Transpose cause and effect? Change pace? Change schedule?

Reverse?

Transpose positive and negative? How about opposites? Turn it backward? Turn it upside down? Reverse roles? Change shoes? Turn tables? Turn other cheek?

Combine?

How about a blend, an alloy, an assortment, an ensemble? Combine units? Combine purposes? Combine appeals? Combine ideas?

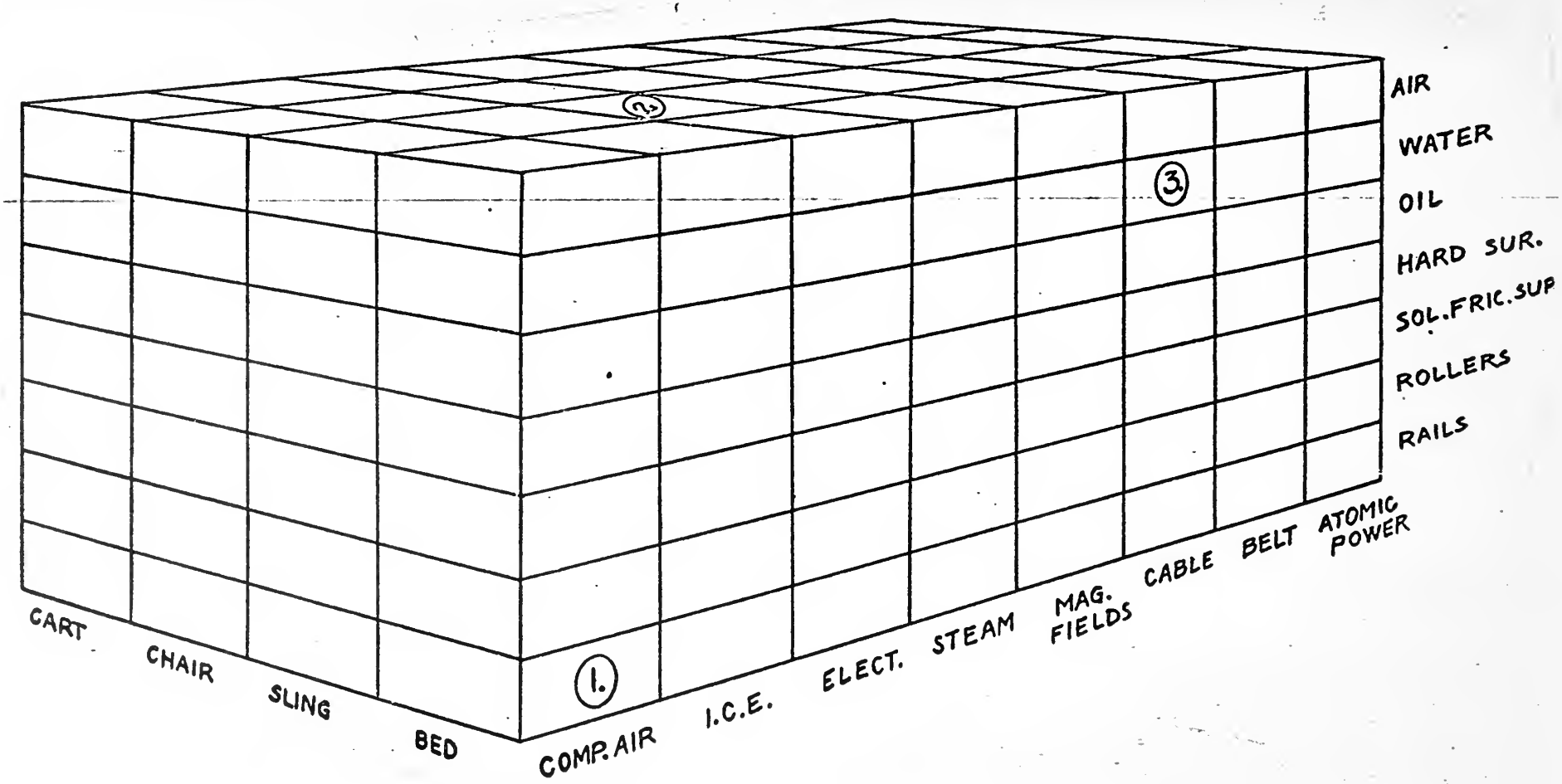
Alex E. Osborn, Applied Imagination (New York: Charles Scribner's Sons, 1953), p. 284.

APPENDIX C

EXAMPLE OF ATTRIBUTE LISTING

Problem: Develop variation for a common wooden lead pencil.

Attribute	Possible changes
Lead produces writing	Light might be used to affect photographic paper. Heat might be used to affect a special paper. Could use a solution instead of solid lead or might use a chemical solution that reacted with the paper. (Some of these variations might lead to a pencil or writing instrument that never had to be sharpened or refilled.)
Wooden Casing	Could be metal; plastic; entirely graphite.
Plain yellow color	Could be any color; carry advertising; or have a design. (Perhaps women would buy pens and pencils having the same designs as their dresses.) Have transparent outer barrel into which dress material could be inserted.



MORPHOLOGICAL ANALYSIS.

John G. Arnold, "Useful Creative Techniques," Creative Engineering Seminar, 1959, (Stanford, Stanford University, 1959), p. 9.

APPENDIX D

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A study of creative thinking as it relat
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